UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

April 30, 2001

Memorandum

SUBJECT: Summary of HED's Reviews of Outdoor Residential Exposure Task Force (ORETF) Chemical Handler Exposure Studies; MRID 449722-01. ORETF Study Numbers OMA001, OMA002, OMA003, OMA004.

FROM: Gary Bangs
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The purpose of this memorandum is to summarize the EPA secondary reviews of the surrogate chemical handler studies submitted by the Outdoor Residential Exposure Task Force (MRID 449722-01) in response to the March 3, 1995, Data Call-In. The primary reviews were completed by Pesticide Management Regulatory Agency, Health Canada at various times during the year 2000. These studies have undergone individual secondary review and have been approved by the Exposure Advisory Council (Expo SAC). Guidance is provided to assist the risk assessor in interpreting the unit exposure values to best apply the appropriate statistic for specific exposure situations. This guidance references the 1992 update of the EPA Exposure Assessment Guidelines as well as several internal memoranda on appropriate utilization of statistical metrics.

cc: J. Evans (Exposure SAC Chair)
V. Bergeron (PMRA, Health Canada)

I. Executive Summary

In 1999, The Outdoor Residential Exposure Task Force (ORETF) completed four studies which were designed to provide representative, or "generic" surrogate exposure data for pesticide handler risk assessment. The studies were designed by the Task Force, which included input from representatives of the crop protection field, regulatory agencies, and commercial applicators. The studies monitored professionals applying granular formulation by push spreader and various formulations by pressurized hose-end "handgun" or spraygun; and volunteers representing non-professional consumers applying granular formulation by push spreader and liquid formulations by garden hose-end sprays. The purpose of this document is to give an overview of those studies and the resulting unit exposures and explain how best to use these data in light of current HED policy.

Overall, the four ORETF studies were well-conducted and the data for all scenarios is considered of better quality and quantity than what is currently contained in the Pesticide Handler Exposure Database (PHED). Most field dosimeter samples exceeded the level of quantification, with the exception of face and neck wipes. Most quality controls (laboratory and field fortification recoveries) were within the parameters prescribed by Agency guidelines.

Selection of the Proper Statistical Measure

The Exposure Assessment Guidelines used by HED, last updated in 1992, recommend the use of the following statistics for the corresponding data distributions:

Data Distribution Type	Appropriate Statistic for Risk Assessment
Lognormal	Geometric Mean
Normal	Arithmetic Mean
Neither Normal nor Lognormal	Median

The geometric mean approximates the median of a lognormal data set, while the arithmetic mean approximates the median of a normal data set. Since much of the exposure data available to HED falls into lognormal or other distribution types, the geometric mean and median have been used extensively as the preferred measures of central tendency. The submitted dermal and inhalation data sets were examined for each application method individually, using the *W* test developed by Shapiro and Wilk (otherwise known as the Shapiro-Wilk test). This test was used to determine whether the data set was drawn from an underlying normal (or lognormal) distribution.

II. ORETF Study Summaries

1. OMA001: LCO Granular Push-Spreader

A loader/applicator study was performed by the Outdoor Residential Exposure Task Force (ORETF) using Dacthal (active ingredient DCPA, dimethyl tetrachloroterephthalate) as a surrogate compound to determine "generic" exposures of lawn care operators (LCOs) applying a granular pesticide formulation to residential lawns. Surrogate chemicals were chosen by the Task Force for their representativeness based on physical chemical properties and other factors. Dacthal, which was the surrogate chemical used for the granular spreader and low-pressure hand gun sprayer studies, has a molecular weight of 331.97 and a vapor pressure of 1.6×10^{-6} mm Hg, and is believed to be an appropriate surrogate for many relatively nonvolatile pesticides. The study was designed to simulate a typical work day for a LCO applying granular pesticide formulation to home lawns. Each LCO replicate loaded and applied approximately 3.3 lbs ai (360 lbs formulated product) over a period of about 4 hours to 15 simulated residential lawns (6480 ft^2 each) with a rotary type spreader. The average industry application rate of 2 lbs ai/acre was simulated (actual rate achieved was about 1.9 lbs ai/acre). The monitoring period included simulated driving, placing the spreader onto and off of the truck, carrying and loading the formulation in the spreader, and the actual application. Incidental activities such as repairs, cleaning up spills, and disposing of empty bags were monitored.

A total of 40 replicates (individual test subjects) were monitored using passive dosimetry (inner and outer whole body dosimeters, hand washes, face/neck wipes, and personal inhalation monitors with OVS tubes). Inhalation exposure was calculated using an assumed respiratory rate of 17 Lpm (1 m^3/hr) for light work (NAFTA,1999), the actual sampling time for each individual, and the pump flow rate. All results were normalized for lb a.i. handled. Twelve professional lawn care operators (LCO) participated in the study. Ten individuals per day (20 per site) were monitored over 4 days at 2 different sod farms near Columbus, Ohio. Each replicate consisted of a LCO loading and applying approximately 3.3 lbs ai / 360 lbs formulated product (1.5 kg ai/ 163 kg formulated product) to 15 simulated residential lawns, for an approximate total duration of 4 hours and total area of 2.2 acres (0.9 ha). Twenty test subjects wore chemical-resistant gloves during all loading and application activities and moving the spreader on and off the truck, then removed and place the gloves in the truck during simulated driving time. The other twenty test subjects did not wear gloves during any activity. Each test subject wore long sleeve cotton shirts and pants over one-piece cotton inner dosimeters. Both outer and inner dosimeters were analyzed to estimate potential exposure for a number of clothing scenarios.

Nearly all samples (for every body part and for inhalation) were above the level of quantitation (LOQ) for dacthal (the level of detection, or LOD was not reported). Where results were less than the reported LOQ, ½ LOQ value was used for calculations, and no recovery corrections were applied. The overall laboratory recoveries (83-101%) and field recoveries (73-98%) were within guideline parameters (see Table 1). An data average recovery greater than 90% does not require correction; all data sets beyond this criterion were corrected by PMRA

reviewers for the recovery of the nearest field fortification level. The HED Exposure SAC reviewed the data and recommends using the hand replicates with the corresponding subject's dermal body replicates, rather than combining them in an attempt to increase statistical power (the latter method was favored by PMRA). Keeping the two sets of data separate (20 gloved, 20 ungloved) is considered to be a better representation of an individual's "total" exposure. Therefore the OMA001 data may be classified as "A/B" quality and of "high confidence" (see data grading criteria in Table 2).

This study is of sufficient quality and scope to make it broadly applicable for use as a surrogate chemical in estimating LCO handler exposures. The unit exposure value from the long sleeves and long pants scenario is lower than the unit exposure reported in the current PHED tables. The inhalation unit exposures agree very closely with the current PHED values. The current PHED study contains "C" (or low) grade data and therefore will not be combined with the ORETF study. **Based on the data grading criteria, this study may be used alone for LCO loader/applicators in lieu of the PHED v.1.1 data (August 1998 version).**

Note on statistics: The geometric mean for dermal data should be used, as the dermal data are lognormally distributed (Shapiro-Wilk test). The median is the appropriate statistic for the inhalation data, which is neither normal nor lognormal in distribution. The central tendency statistics for the dermal and inhalation unit exposures (i.e., mg/lb active ingredient handled) are listed in Table 3.

2. OMA002: LCO Handgun Sprayer

A mixer/loader/applicator study was performed by the Outdoor Residential Exposure Task Force (ORETF) using Dacthal as a surrogate compound to determine "generic" exposures to individuals applying a pesticide to turf with a low-pressure "nozzle gun" or "hand gun" sprayer. Dermal and inhalation exposures were estimated using whole-body passive dosimeters and breathing-zone air samples on OVS tubes (biological monitoring data were not collected). Inhalation exposure was calculated using an assumed respiratory rate of 17 Lpm for light work (NAFTA,1999), the actual sampling time for each individual, and the pump flow rate. All results were normalized for lb a.i. handled. A total of 90 replicates were monitored using 17 test subjects. Four different formulations of dacthal [75% wettable powder/WP (packaged in 4lb and 24 lb bags), 75% wettable powder in water soluble bags/WSB (3 lb bag), 75% water dispersible granules/WDG (2 lb bag) and 55% liquid flowable/FL (2.5 Gal container)] were mixed, loaded, and/or applied by five different LCOs to actual residential lawns at each site in three different locations (Ohio, Maryland, and Georgia), for a total of fifteen replicates per formulation. An additional ten replicates at each site were monitored while they performed spray application only (using 75% wettable powder formulation).

A target application rate of 2 lb ai/acre was used for all replicates (actual rate achieved was about 2.2 lbs ai/acre). Each replicate treated a varying number of actual client lawns to

attain a "representative" target of 2.5 acres (1 hectare) of turf. This is approximately one-half the 5 acres typically used in HED exposure estimates for LCOs applying pesticides with a hand gun controlled pressurized system for an 8-hour work day. The application times varied considerably between replicate because of the study design, but total sampling time was meant to simulate a full day of spraying customer lawns. The exposure periods averaged five hours twenty-one minutes, five hours thirty-nine minutes, and six hours twenty-four minutes, in Ohio, Maryland and Georgia, respectively. Average time spent actually spraying at all sites was about two hours. All mixing, loading, application, adjusting, calibrating, and spill clean up procedures were monitored, except for typical end-of-day clean-up activities (e.g. rinsing of spray tank, etc.).

Dermal exposure was measured using inner and outer whole body dosimeters, hand washes, face/neck washes, and personal air monitoring devices. All test subjects wore one-piece, 100% cotton inner dosimeters beneath 100% cotton long-sleeved shirt and long pants, rubber boots and nitrile gloves. Gloves are typically worn by most LCOs, and required by many pesticide labels for mixing and loading. Overall, residues were highest on the upper and lower leg portions of the dosimeters

In general, concurrent laboratory fortifications produced mean recoveries in the range of 78-120%, with the exception of OVS sorbent tube sections which produced mean recoveries as low as 65.8% (see Table 1). With the exception of the lowest OVS tube spike level on the 14th day, the variation in mean field recoveries between sampling days did not exceed a coefficient of variation (CV) of 25%; the same was true for mean recoveries for each of the three general sites (Ohio, Maryland, and Georgia). Adjustment for recoveries from field fortifications were performed on each dosimeter section or sample matrix for each study participant, using the mean recovery for the closest field spike level for each matrix and correcting the value to 100%. Using the grading criteria in Table 2, the data for this study are for the most part "B" or better, and the study meets the criterion for minimum replicates (15 or more per body part). Therefore OMA002 may be ranked "high confidence" data. Most residues were above the limit of quantitation. Where results were less than the reported LOQ, ½ LOQ value was used for calculations, and no recovery corrections were applied.

The values for dermal and inhalation unit exposures in the PHED are based on a single applicator study and are of C-grade. The unit exposures in PHED are for a single layer of clothing with gloves only, and are in the range of the values in the ORETF data for this same scenario and clothing. The mean inhalation value is nearly the same in both studies. This study is of sufficient quality and scope to make it broadly applicable for use as a surrogate chemical in estimating LCO exposures. The PHED v. 1.1 study only contains applicator data and does not consider LCOs who mix their own pesticide each day. There were only 14 replicates in the PHED study, all of whom wore gloves, and the data were of lower quality. **Because the ORETF study was of AB grade and exceeded the criterion for replicates, the ORETF data should be used instead of the lower-confidence PHED LCO study.**

Note on statistics: The dermal and inhalation data for the different formulations used are a

mixture of lognormal, normal and "other" distributions. Dermal data for liquid flowable and wettable powder mixer/loader applicators were lognormally distributed (Shapiro-Wilk test); the appropriate central tendency measures are the geometric means. Dermal data for WDG and WSB for mixer/loader/applicators were neither normal nor lognormal, as were applicator data for wettable powder use; the medians of the data are the central tendency measures for these formulations. The inhalation data for liquid flowable mixer/loader/applicators were normal, and the mean should be used. The other mixer/loader applicator inhalation data were lognormal, so the geometric means of those data sets should be used. Applicator dermal and inhalation data were neither normal nor lognormal (Shapiro-Wilk test), so the medians of those data should be used.

3. OMA003: Resident-applicator Granular Push-Spreader

A mixer/loader/applicator study was performed by the ORETF using Dacthal as a surrogate compound to determine "generic" exposures of individuals applying a granular pesticide formulation to residential lawns.

A total of 30 volunteer test subjects were monitored using passive dosimetry (inner and outer whole body dosimeters, hand washes, face/neck wipes, and personal inhalation monitors). Each test subject carried, loaded, and applied two 25-lb bags of fertilizer (0.89% active ingredient) with a rotary type spreader to a lawn (a turf farm in North Carolina) covering 10,000 ft^2 (one bag to each of the two 5000 ft^2 test plots). Application to each subplot continued until the hopper was empty. Each participant also disposed of the empty bags at the end of the replicate. The target application rate was 2 lb ai/acre (actual rate achieved was about 1.9 lbs ai/acre). The average application time was 22 minutes, including loading the rotary push spreader twice, applying the treated fertilizer, and disposing of the empty bags. Each individual, or "replicate" handled approximately 0.45 lbs ai.

Dermal exposure was measured using inner and outer whole body dosimeters, hand washes, face/neck washes, and personal air monitoring devices with OVS tubes. Overall, residues were highest on the upper and lower leg portions of the dosimeters. Inhalation exposure was calculated using an assumed respiratory rate of 17 Lpm for light work (NAFTA,1999), the actual sampling time for each individual, and the pump flow rate. Exposures were highly variable between individuals (range 0.26-7.6 mg/lb ai).

All fortified samples and field samples collected on the same study day were stored frozen and analyzed together, eliminating the need for storage stability determination. Laboratory and field fortification samples were in liquid form (not granular). Seventy-seven percent (77%) of the face and neck washes were below the level of quantitation (LOQ) for dacthal, and ten percent (10%) of the air samples were also at or below the LOQ. Where results were less than the reported LOQ, ½ LOQ value was used for calculations, and no recovery corrections were applied. Laboratory recoveries for all matrices were in the range of 83-99%

(Table 1). Mean field fortification recoveries over the four study days for each fortification level ranged from 83 to 97%. These recovery ranges meet the criteria for grade A/B data (Table 2). As stated in the PMRA review, the data were highly variable (standard deviations of data were often equal to or greater than the mean):

"Although this study was done with volunteer applicators, and the study in PHED used professionals, the unit exposures were much lower in the ORETF study. Even with long sleeves and long pants, the PHED data exceeds all but the highest unit exposures in this study.
The dermal and inhalation data combined were neither normal nor lognormal in distribution.
The very large ranges of results and the standard deviations should be taken into account when using this data as a surrogate for other exposure assessments. The large range of results shows that even in a controlled experimental scenario such as this, the results between individuals is quite large. This range is likely due to differences in personal technique, handling practises, and care during application. Although some of the high results were justified by field observations of handling and application practise, other high results could not be explained. Based on the sample size (n=30), the range of results should be considered typical for homeowners applying granular products to turf."

The study results were corrected by PMRA for the recovery of the nearest field fortification level on that sampling day. Overall, quality assurance and control measures were adequate for the field study. This study is of sufficient quality and scope to make it broadly applicable for use as a surrogate chemical in estimating residential handler exposures. The currently published PHED study is of C grade (dermal replicates = 0 to 15, C grade; hand replicates = 15; no head or neck replicates; data C grade; inhalation 15 replicates, data B grade). The PHED study was also done with professional applicators, whereas this study used non-professional volunteers and is therefore more applicable to residential handlers. **The ORETF study data should be used instead of the PHED v. 1.1/Residential SOP data for this scenario.**

Note on statistics: It is appropriate to use the geometric mean of the exposure data, as the dermal and inhalation data are lognormally distributed.

4. OMA004: Hose-end Spray - Resident Applicators

A mixer/loader/applicator study was performed by the ORETF using diazinon (25% EC) as a surrogate compound to determine "generic" exposures to individuals applying a pesticide to turf with a garden hose-end sprayer. Diazinon has a relatively high vapor pressure (1.4×10^{-4} mm Hg), and has been shown in other proprietary studies to be present at quantifiable levels in outdoor air after turf applications. Therefore, diazinon should be considered to represent relatively higher inhalation exposure than most pesticides. Dermal and inhalation exposures were estimated using passive dosimetry techniques (biological monitoring data were not collected). A total of 60 replicates were monitored using 30 test subjects (two replicates each). This study is unusual in that homeowner-volunteers sprayed actual residential lawns in Frederick, Maryland, rather than test plots. Thirty applicator replicates were monitored using a ready-to-use (RTU) product (Bug-B-Gon) packaged in a 32 fl. oz. screw-on container. These

containers were attached to garden hose-ends. An additional 30 mixer/loader/applicator replicates were monitored using Diazinon Plus also packaged in 32 fl. oz. plastic bottles. This product required the test subjects to pour the product into dial-type sprayers (DTS) that were attached to garden hose-ends.

A nominal application rate of 4 lb ai/acre was used for all replicates. Each replicate monitored the test subject treating 5,000 ft^2 of turf and handling a total of 0.5 lb ai/replicate. The average total mixing/loading/spraying time per replicate was 75 minutes. Dermal and inhalation exposure were measured using inner and outer whole body dosimeters (long pants and long sleeved shirt over long underwear), hand washes, face/neck washes, and personal air monitoring devices. Lab-fortified dosimeters had recoveries of 87-103%; field-fortified dosimeters had a mean range of 79-104% recovery, with very little variance (see Table 2). Based on the numbers of replicates and the range of lab and field recoveries, these study data may be graded "A" and "high confidence" based on the PHED criteria (see Table 1). The study results are corrected for field recoveries using the correction factor for the level of fortification closest to the field result.

The conventional ("mix your own") hose-end sprayer exposure data in the 1998 v. 1.1 of the PHED are based on a single study with 8 replicates and no bare hand data (patch dosimeters and gloves were used. There were no field fortification data and few replicates, so the study data were rated "E" grade and low confidence. **Therefore, the study currently in PHED should be replaced by ORETF data due to the increased data quantity and quality control in the later study.**

Note on statistics: The route-specific exposure data (dermal and inhalation) from both the ready-to-use and "mix your own" combined loading and application scenarios were lognormally distributed (Shapiro-Wilk test). Therefore, the geometric mean of the dermal and inhalation data should be used for exposure assessments.

Table 1. Grading ORETF Studies

Study Number	% Lab Recovery	% CV* for Lab recovery [Range]	Mean Dosimeter[1] % Field Recovery	% Storage Stability	Data Corrected For:**
OMA001 LCO Spreader	83-101	8 [5-12]	73-98	Not Required: field samples and forts. stored together	Field Recovery
OMA002 LCO Hand Gun Spray	78-120 [except one at 66]	<8 [2-21]	71-104	" "	Field Recovery
OMA003 Resident Spreader	83-99	<7 [2-13]	83-97	" "	Field Recovery
OMA004 Resident Hose-end Spray	87-103	8 [2-12]	79-104	Not reported (but lab and field recoveries similar)	Field Recovery

[1] = Mean of recovery for each type of dosimeter for each level of fortification
* % CV = Average Percent Coefficient of Variation (standard deviation/mean x 100%) across all matrices and levels of fortification; [range]
** If a field recovery of 90% or greater is obtained, no correction of the data is necessary

Table 2. Grading PHED Studies

Each study in PHED has been graded from "A" to "E" according to certain QA/QC factors

Data Grade	% Lab Recovery	CV* for Lab recovery	% Field Recovery	% Storage Stability	Data Corrected For:***
A	90-110	≤15	70-120	**	Field Recovery
B	80-110	≤25	50-120	**	Field Recovery
C	70-120 70-120	≤33 ≤33	30-120 or missing	** 50-120	Field Recovery
D	60-120	≤33	**	**	Field Recovery if available; if not then storage stability, if not then lab recovery
E	**Does not meet above criteria**				

* CV = Coefficient of Variation
** Does not matter if available or missing
*** If a field recovery of 90% or greater is obtained, no correction of the data is necessary

DATA CONFIDENCE

Data confidence refers to both the **quality** and the **amount** of data for each PHED run. Each study in PHED has been graded from "A" to "E" according to certain Quality Assurance/Quality Control (QA/QC) factors:

High Confidence Run/: AB GRADE/15 Reps

Grades A and B **-AND-** at least 15 replicates per body part. PHED runs having any combination of A or B grade data are listed as "AB grade" data in the tables.

Medium Confidence Run: ABC GRADE/15 Reps

Grades A, B, or C **-AND-** at least 15 replicates per body part. PHED runs having any combination of A, B, and C grade data are listed as "ABC grade" data in the tables.

Low Confidence Run/: "ALL GRADE"

Any run that includes D or E grade data **- OR -** has less than 15 replicates per body part. PHED runs which include "D" or "E" grade data are referred to as having **"ALL GRADE" data**. "ALL GRADE" data are always low confidence.

Table 3: ORETF LCO Exposure Study Data Summary (MRID 449722-01)						
Application Method/Job Function Study Number	Statistic	Total Dermal Unit Exposure (mg/lb ai)			Inhalation Unit Exposure [1]	
		Single Layer, No Gloves	Single Layer, With Gloves	Coveralls and Gloves[2]	(mg/lb ai)	(mg/m^3/lb ai)
(1) LCO Push Cyclone Granular Spreader OMA001[3] [20 Gloved and 20 ungloved replicate data separated]	Std Dev	0.42	0.18	0.09	0.0068	0.0017
	Min	0.12	0.1	0.051	0.0003	7.8 e-05
	GM	0.35	0.22	0.11	0.0071	0.0017
	Median	0.38	0.21	0.11	0.0075	0.0017
	AM	0.45	0.25	0.13	0.0094	0.0023
	Max	2.1	0.95	0.48	0.029	0.0072
	90th %	0.62	0.33	0.17	0.021	0.0049
(2a) LCO Handgun Spray Mixer/Loader Applicator OMA002 Liquid Flowable[4] [15 replicates]	Std Dev	No Ungloved Data	1.1	0.53	0.0011	0.00017
	Min		0.056	0.037	0.00041	0.0001
	GM		0.5	0.27	0.015	0.00025
	Median		0.36	0.21	0.0018	0.00024
	AM		0.95	0.49	0.0019	0.00029
	Max		3.5	1.8	0.0035	0.0006
	90th %		2.4	1.2	0.0034	0.00052
(2b) LCO Handgun Spray Mixer/Loader Applicator OMA002 Water-Dispersible Granules[4] [15 replicates]	Std Dev	No Ungloved Data	3.4	1.7	0.044	0.0067
	Min		0.18	0.092	0.0038	0.00076

Table 3: ORETF LCO Exposure Study Data Summary (MRID 449722-01)						
Application Method/Job Function Study Number	Statistic	Total Dermal Unit Exposure (mg/lb ai)			Inhalation Unit Exposure [1]	
		Single Layer, No Gloves	Single Layer, With Gloves	Coveralls and Gloves[2]	(mg/lb ai)	(mg/m^3/lb ai)
	GM		0.69	0.37	0.0022	0.0039
	Median		0.59	0.34	0.0022	0.004
	AM		1.8	0.93	0.0039	0.0065
	Max		11	5.7	0.16	0.22
	90th %		5.8	2.9	0.093	0.017
(2c) LCO Handgun Spray Mixer/Loader Applicator OMA002 Wettable Powder in Water Soluble Bags [4] [15 replicates]	Std Dev	No Ungloved Data	1.2	0.6	0.024	0.0036
	Min		0.3	0.16	0.0088	0.00015
	GM		0.69	0.37	0.0077	0.0012
	Median		0.65	0.36	0.0066	0.0011
	AM		0.96	0.5	0.017	0.0027
	Max		5.1	2.6	0.088	0.012
	90th %		1.2	0.66	0.043	0.0072
(2d) LCO Handgun Spray Mixer/Loader Applicator OMA002 Wettable Powder [4] [15 replicates]	Std Dev	No Ungloved Data	1.4	0.69	0.31	0.048
	Min		0.19	0.11	0.0025	0.0005
	GM		0.74	0.4	0.062	0.01
	Median		0.56	0.3	0.07	0.01

Table 3: ORETF LCO Exposure Study Data Summary (MRID 449722-01)						
Application Method/Job Function Study Number	Statistic	Total Dermal Unit Exposure (mg/lb ai)			Inhalation Unit Exposure [1]	
		Single Layer, No Gloves	Single Layer, With Gloves	Coveralls and Gloves[2]	(mg/lb ai)	(mg/m^3/lb ai)
	AM		1.2	0.62	0.18	0.028
	Max		5	2.5	1.2	0.19
	90th %		2.8	1.4	0.36	0.053
(2e) LCO Handgun Sprayer Applicator Only OMA002 WettablePowder[4] [30 replicates]	Std Dev	No Ungloved Data	4.2	2.1	0.0012	0.00025
	Min		0.25	0.13	1.4 e-05	1.6 e-06
	GM		0.75	0.4	0.001	0.00019
	Median		0.73	0.4	0.001	0.00019
	AM		1.6	0.85	0.0015	0.00028
	Max		23	12	0.053	0.0011
	90th %		1.8	0.92	0.0029	0.00055

[1]Air concentration (mg/m^3/lb ai) calculated using NAFTA '99 standard breathing rate of 17 lpm (1 m^3/hr)
[2]Exposure calculated using OPP/HED 50% protection factor (PF) for cotton coveralls on torso, arms, legs.
[3]20 handlers wore long sleeves, long pants, gloves; 20 handlers wore long sleeves, long pants, No gloves.
[4]All commercial handlers wore long pants, long-sleeved shirt, nitrile gloves and shoes.
SHADED AREA = Appropriate statistic for exposure assessment use based on statistical distribution of data set (i.e., lognormal, etc.)
Std Dev = Standard Deviation
Min = Minimum value
GM = Geometric mean
AM = Arithmetic mean [average]
Max = Maximum value
90th % = 90th Percentile

Table 4: ORETF Resident-Applicator Exposure Study Data Summary						
Application Method/Job Function Study Number	Statistic	Total Dermal Unit Exposure (mg/lb ai)			Inhalation Unit Exposure [1]	
		Short Pants, Short Sleeves	Long Pants, Short Sleeves	Long Pants, Long Sleeves	(mg/lb ai)	(mg/m^3/lb ai)
Resident-applicator Granular Push Spreader[2] OMA003 [30 replicates, no gloves]	Std Dev	1.3	0.13	0.12	0.00098	0.0023
	Min	0.26	0.026	0.02	0.00013	0.00019
	GM	0.68	0.089	0.076	0.00091	0.0018
	Median	0.63	0.072	0.058	0.00078	0.0018
	AM	0.94	0.13	0.12	0.0012	0.0026
	Max	7.6	0.52	0.51	0.0037	0.0096
	90%	1.2	0.26	0.26	0.0029	0.006
Resident Applicator: Hose-end Sprayer: Ready-to-Use (no mixing)[3] OMA004 [30 replicates]	Std Dev	8	2	1.9	0.017	0.015
	Min	0.078	0.029	0.017	0.00067	0.00072
	GM	2.6	0.45	0.26	0.011	0.0094
	Median	3.2	0.53	0.26	0.015	0.013
	AM	6.3	1.1	0.88	0.018	0.016
	Max	33	9.9	9.3	0.065	0.068
	90th %	14	1.4	1.2	0.038	0.03

Table 4: ORETF Resident-Applicator Exposure Study Data Summary						
Application Method/Job Function Study Number	Statistic	Total Dermal Unit Exposure (mg/lb ai)			Inhalation Unit Exposure [1]	
		Short Pants, Short Sleeves	Long Pants, Short Sleeves	Long Pants, Long Sleeves	(mg/lb ai)	(mg/m^3/lb ai)
Resident Mixer/loader/applicator: Hose-end Sprayer: "Mix your own"[3] OMA004 [30 replicates]	Std Dev	11	7.1	6.5	0.02	0.014
	Min	2.6	0.36	0.22	0.00052	0.0024
	GM	11	6.2	5.6	0.016	0.013
	Median	9.9	7	6.3	0.016	0.013
	AM	14	8.7	8.1	0.024	0.017
	Max	49	27	26	0.088	0.051
	90th %	30	21	20	0.052	0.037

[1] Air concentration (mg/m^3/lb ai) calculated using NAFTA '99 standard breathing rate of 17 lpm (1 m^3/hr).

[2] Shorts and short-sleeved shirt worn.

[3] Long pants, long sleeve shirt, no gloves worn. Short sleeves calculated from dosimeter.

SHADED AREA = Appropriate statistic for exposure assessment use based on statistical distribution of data set (i.e., lognormal, etc.)

Std Dev = Standard Deviation

Min = Minimum value

GM = Geometric mean

AM = Arithmetic mean [average]

Max = Maximum value

90th % = 90th Percentile

13544

025703

Chemical:	**Chemical Unknown**
PC Code:	**000000**
HED File Code	**12000 Exposure Reviews**
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